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PROGRESSING FROM BRIEF ASSESSMENTS TO EXTENDED EXPERIMENTAL ANALYSES IN THE EVALUATION OF ABERRANT BEHAVIOR

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The role of experimental analyses in guiding treatment is well established. However, not all experimental analyses yield conclusive results. Outcomes may be inconclusive due to time limitations that preclude extended observation and detailed experimental manipulations, or may result from interactions across experimental conditions, multiple control, or other unknown factors. In this study, we describe an assessment sequence that moves through four phases beginning with relatively brief (1 to 2 hr) analyses and culminating in extended analyses that may control for experimental confounding effects (e.g., interaction effects). Data illustrating the model are presented for 20 individuals referred for severe behavior problems including self-injury, aggression, stereotypy, and tantrums. Analyses were considered to be complete only when clear and replicable response patterns emerged. Results showed that clear and replicable response patterns emerged for 85% of the participants.

DESCRIPTORS: functional analysis, aberrant behavior, developmental disabilities

In the past 10 years, there has been a growing emphasis on functional analysis as a form of assessment for aberrant behavior. As has been well documented, identification of operant behavioral functions may allow researchers or practitioners to (a) withhold reinforcers that maintain aberrant behavior, (b) present those reinforcers contingent on appropriate alternative behavior, or (c) alter the reinforcing efficacy of consequent events (Mace, 1994). One of the best examples of the utility of basing treatment on the outcome of a functional analysis is functional communication training (FCT) (Carr & Durand, 1985), in which aberrant behavior is no longer reinforced and alternative communicative behavior functionally replaces the aberrant behavior (because it is reinforced with the same consequences that previously had maintained the aberrant behavior). For example, if aberrant behavior is maintained by contingent attention, the individual may be taught alternative ways to solicit attention (Durand & Carr, 1992).

In addition to its clinical utility, functional analysis may serve as a form of basic research, designed to learn more about why aberrant human behavior occurs. For example, little was known about the behavioral mechanisms supporting self-injurious behavior (SIB) until systematic analyses identified specific operant functions for the behavior (Carr, 1977; Iwata, Dorsey, Slifer, Bauman, & Richman, 1982/1994). An analogy may be drawn to other areas of scientific research, such as medicine. Medical researchers interested in identifying the causes of certain diseases may simultaneously discover treatments for the disease. Similarly, behavior analysts interested in why behavior occurs may be well equipped to prescribe appropriate interventions. Thus, functional analysis represents what is perhaps a unique link between basic and applied behavioral research.

Most current functional analysis procedures are designed either to identify or to rule out social contingencies such as positive reinforcement (attention or tangible) or negative reinforcement (escape from aversive environmental

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stimulation). For example, in experimental analyses, test conditions are arranged such that participants are exposed to particular antecedent and consequent events. If high rates of aberrant behavior are consistently correlated with a particular test condition, the antecedents and consequences are considered to be functionally related to the behavior problem. In addition, some assessments have shown that aberrant behavior can persist in the absence of social contingencies (e.g., Iwata, Pace, et al., 1994). Thus, functional analyses usually contain at least one condition in which a participant is observed either alone or with no interaction.

Assessment methods designed to identify operant functions include structured interviews and rating scales (e.g., Durand & Crimmins, 1988; O'Neill, Horner, Albin, Storey, & Sprague, 1990), descriptive analyses and hypothesis testing (e.g., Mace & Lalli, 1991; Repp & Karsh, 1994), and structured experimental analyses in analogue settings (e.g., Iwata et al., 1982/1994). Although methodological refinements may be useful for all types of functional assessments, the focus of our study was to evaluate refinements of analogue experimental analyses that may (a) reduce the overall observation time of some assessments and (b) increase the likelihood of identifying behavioral functions. Specifically, this study illustrates a model in which assessment formats progress from relatively brief (1 to 2 hr) analyses to more extended analyses when behavioral function is not quickly identified. This may help to establish an empirical foundation for decision making when conducting functional analyses based on the procedures outlined by Iwata et al. (1982/1994).

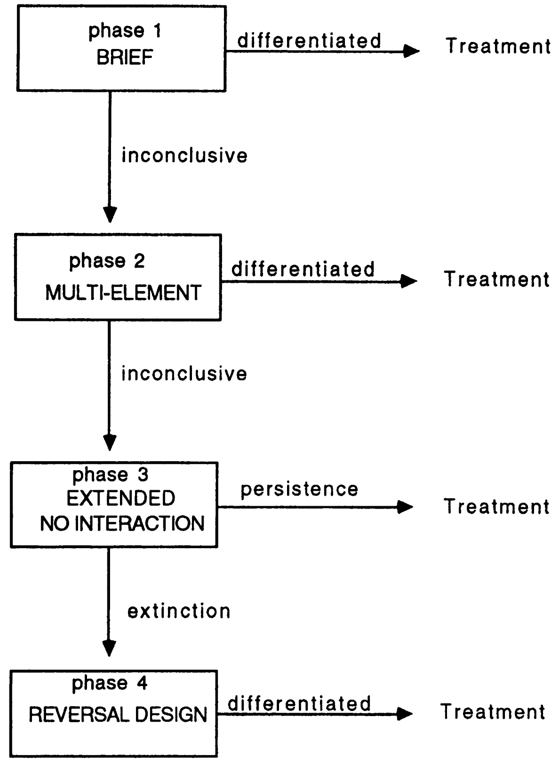

Figure 1. Chart of the functional analysis model. Clients progress to treatment only after a functional analysis yields consistent and predictable patterns of behavior.

DEVELOPMENT OF THE MODEL

Our assessment conditions were based on those described by Iwata et al. (1982/1994), although slight variations were incorporated (see Method). Briefly, the method involves exposing participants to four general test conditions: positive reinforcement, negative reinforcement, alone, and play (control). We selected this method because it is perhaps the most frequently used analogue assessment method and because recent epidemiological data support its utility in identifying the functions of aberrant behavior (Iwata, Pace, et al., 1994). In addition, the focus of the study was on analogue assessments rather than on interview or descriptive assessment methods. Using visual data analysis only, our model was developed according to the following criteria: (a) A given assessment was conducted until differentiated response patterns were produced or undifferentiated patterns were stabilized using appropriate experimental designs, and (b) assessment was completed as quickly as possible given the constraints of the first criterion.

Figure 1 summarizes the model. Phase 1 was designed to complete an assessment as quickly as possible while attempting to establish as much experimental control as possible. Although response differentiation, experimental control, and brevity may be difficult to establish simultaneously, recent research in clinical settings has demonstrated that all three criteria may be approached (e.g., Cooper, Wacker, Sasso, Reimers, & Donn, 1990; Northup et al., 1991). For example, Northup et al. demonstrated that aberrant behavior occurred at differentially high rates for 1 participant when attention was presented contingent on aggression, and they were able to replicate the finding during a 90-min clinic session. Although subsequent research has shown that not all brief assessments produce differentiated outcomes (Derby et al., 1992), an analysis of within-session response patterns may aid in the interpretation of assessment data. For example, Vollmer, Iwata, Zarcone, Smith, and Mazaleski (1993) found that within-session response patterns sometimes clarified the results of brief assessments and extended functional analyses. In that study, 1 participant showed undifferentiated response patterns when data were plotted as overall session rates, but analysis of data on a within-session basis showed that all sessions following attention sessions yielded bursts of behavior that may have been extinction induced; these extinction bursts inflated the overall session means. Thus, in our model, a brief assessment using alternating conditions and within-session data analysis is the first step in the process. If the brief assessment produces differentiated outcomes, the participant may then move to a treatment evaluation based on the identified behavioral function.

It should be noted that Phase 1 is not being recommended as a terminal point in the functional analysis; rather, it is presented as an option for two general circumstances: (a) when clinical constraints preclude extended analyses or (b) when more extended treatment evaluations can further confirm functional relationships. For example, if escape is indicated as a possible source of reinforcement during assessment, the functional relationship can be further evaluated during a comparison of baseline and treatment conditions in which escape is alternately presented and withheld contingent upon the target response or alternative behaviors.

At times, brief assessments (Phase 1) may produce undifferentiated outcomes because a participant has not discriminated the experimental conditions or is responding to idiosyncratic events correlated with the novelty of sessions and new environments; thus, repeated exposure to experimental conditions may be required. The logic of repeated measures to obtain response differentiation and to demonstrate experimental control as quickly as possible apparently led Iwata et al. (1982/1994) to select the multielement design as a standard assessment format (Iwata, Pace, et al., 1994). Thus, in our model, when brief assessment (Phase 1) does not produce differentiated outcomes, a participant is exposed to experimental conditions in a more extended multielement format (Phase 2) until response differentiation is achieved and experimental control is established. It should be noted that the experimental design is extended from Phase 1 to Phase 2. If the multielement assessment produces differentiated outcomes, the participant may then move to a treatment evaluation based on the identified behavioral function.

Phase 3 is designed as an extension of the multielement format. Although multielement designs (Phase 2) increase the likelihood of response differentiation in comparison to brief assessments (Derby et al., 1992; Iwata, Pace, et al., 1994), the multielement design may still, at times, yield inconclusive outcomes as a result of many different factors, including (a) a failure to discriminate experimental conditions in effect (Vollmer, Iwata, Duncan, & Lerman, 1993), (b) interaction effects across conditions (Higgins Hains & Baer, 1989), (c) multiply controlled behavior (Day, Horner, & O'Neill, 1994; Smith, Iwata, Vollmer, & Zarcone, 1993), or (d) behavior that is not maintained by social contingencies and therefore will persist in their absence (Vollmer, Marcus, & LeBlanc, 1994). One way to test whether undifferentiated responding is a result of one or more of the above factors is to observe the participant repeatedly in an alone or no-consequences condition. If the behavior is maintained by social consequences only, it should extinguish (Vollmer, Iwata, Duncan, & Lerman, 1993). In other words, previously high levels of behavior in the no-interaction sessions during Phase 2 may have resulted from carryover effects from one session to the next (e.g., an extinction burst in a no-interaction session that follows an attention session). If the behavior is not maintained by social consequences, it should persist at levels similar to those observed during the multielement assessment (Vollmer et al., 1994). It is possible that social consequences may exacerbate the behavior, but persistent rates in the absence of social contingencies suggest that social contingencies are not the primary maintaining factor. Thus, the third step in our model involves observing the participant in repeated no-interaction conditions, in which there are no programmed social consequences for the aberrant behavior. If the behavior persists, the participant may then proceed to a treatment evaluation based on the presumption that the behavior is not maintained by social consequences (e.g., environmental enrichment, sensory extinction) (Horner, 1980; Rincover, 1978).

Phase 4 is designed as an extension of Phase 3 and is presented if behavior extinguishes during the repeated no-interaction sessions. If the behavior does extinguish in Phase 3 (extended no interaction), it implies that the behavior may be responsive to social reinforcement and had been maintained in the multielement assessment (Phase 2) as a result of interaction effects or a failure to discriminate experimental conditions due to the rapid alternation of conditions (i.e., carryover effects). One way to confirm this possibility is to re-present the social reinforcement conditions in a reversal design (Iwata, Duncan, Zarcone, Lerman, & Shore, 1994; Vollmer, Iwata, Duncan, & Lerman, 1993). Thus, the fourth phase of our model involves observing the participant in sequential exposures to each of the functional analysis experimental conditions in a reversal design. If the fourth phase produces differentiated outcomes, the participant may then proceed to a treatment evaluation based on the identified behavioral function.

We have evaluated this model with 20 children referred for the treatment of severe behavior problems. The following study is designed as an illustration of the model for progressing from brief assessments to more extended functional analyses.

METHOD

Participants and Setting

Table 1 presents demographic information for the 20 children and adolescents who participated in the study. These were 20 of the first 22 children referred to our school-based research project for the assessment and treatment of severe behavior problems. Two children were excluded from the study for medical reasons (their self-injury produced immediate and severe tissue damage when restraint was removed). All children participated with the informed consent of their parents or legal guardians. Sessions were conducted in empty classrooms or therapy rooms in each child's school. The contents of the room were altered depending on the experimental condition in effect. The study was conducted at four different schools: (a) a preschool for children who were experiencing some known learning difficulties or developmental delay, (b) a school for children and adolescents diagnosed with severe and profound mental retardation, (c) a regular education school, in which one of our participants (Sally) attended an integrated prekindergarten class, and (d) a school for children with visual impairments (Guy).

Table 1
Demographic Information

Name	Age (years-months)	Target behaviors	Sex	Diagnosis	Medication
Korey	3-3	Face hitting Ear poking Head banging or sweeping Hand mouthing	M	Cerebral palsy Severe/profound[a]	None
CJ	5-2	Tantrum	M	Autism	None
Mark	4-4	Hand biting Head banging	M	Pervasive developmental disorder	None
Rhonda	4-1	Hand mouthing	F	Rett syndrome	None
Ron	3-7	Aggression	M	Severe/profound[a]	None
Billy	4-11	Head banging Head hitting	M	Severe/profound[a]	None
Robert	3-7	Aggression	M	Pervasive developmental disorder	None
Kevin	18	Head hitting	M	Severe/profound	Tegretol
Harold	3-8	Head banging Eye gouging	M	Severe/profound[a] Seizure disorder	None
Chester	21	Body hitting Head hitting	M	Severe/profound	Haldol
Melba	4	Head banging Face scratching	F	Severe/profound[a]	None
Barry	4-4	Hand biting Hand hitting	M	Severe/profound[a]	None
Guy	7	Head banging Hand biting	M	Blind Severe/profound	None
Rick	4-3	Aggression	M	Unknown	None
Martin	15	Head, face, and back banging	M	Autism	Melaril
Ann	14	Hand biting Hand mouthing	F	Severe/profound	None
David	4-1	Face slapping	M	Severe/profound[a]	None
Todd	16	Face slapping	M	Cerebral palsy	Phenobarb
Terri	4-1	Hand biting Arm biting	F	Unknown	None
Sally	5	Head hitting Aggression Disruption	F	Down syndrome Moderate[a]	None

[a] Indicates probable level of functioning.

Recording and Reliability

Table 2 shows response definitions for the problem behaviors observed during assessment. In general, participants were referred for the assessment and treatment of self-injurious behavior (SIB), aggression, or stereotypy. The primary dependent variable was either responses per minute of aberrant behavior (for discrete responses, such as head hitting) or percentage of 10-s intervals using a partial-interval recording method (for more continuous behavior, such as hand mouthing). Observers were graduate and undergraduate students who were trained in the assessment setting. A trainee observer could record data for any single participant only after completing two consecutive sessions at or above 90% agreement with a previously trained observer for two consecutive ses-

Table 2
Response Topographies

Behavior	Definition
Self-injury	
Head banging	Audible contact between the head, table, chair, floor, or wall.
Head sweeping	Sweeping motion between the head and back of chair.
Head hitting/slapping	Audible contact between the head and hand.
Face scratching	Contact between a fingernail and face.
Back banging	Audible contact between the back and wall, chair, or floor.
Hand or arm biting	Contact between the teeth and hand, finger, thumb, or arm.
Ear poking	Inserting a finger or thumb into the ear canal.
Eye poking	Inserting a finger or thumb into the eye socket.
Tantrum	Head banging, head hitting, audible kicks to objects, and crying.
Aggression	
Hitting others	Audible contact between the participant's hand and another person.
Stereotypy	
Hand mouthing	Breaking the plane of the lips with a hand, finger, or thumb.

sions. Data were almost always collected using hand-held computers, but were occasionally collected on tally sheets when computers were not functioning.

Interobserver agreement was evaluated by having two observers simultaneously and independently record instances of behavior during each 10-min session. Agreement was calculated in two ways, depending on the measure. For rate measures, agreement was calculated by dividing each observation session into 60 10-s intervals and dividing the smaller number of observed instances by the larger number of observed instances within each 10-s interval. The percentage within each interval was then averaged across the 10-min session. For percentage of interval measures, agreement was calculated by dividing the total number of agreements (on occurrence and nonoccurrence) by the total number of intervals. Interobserver agreement was assessed in 38.3% of the sessions overall (range for individual participants, 20% to 100%) and averaged 97.9% overall (range of means for individual participants, 94.3% to 99.7%).

Preassessment Considerations

Prior to conducting the functional analyses, parents and teachers were interviewed to identify problem behaviors, relevant instructional or other problem situations, prior interventions, medications, allergies, and so forth (O'Neill et al., 1990). Also, classroom or home observations were conducted to develop operational definitions of target behaviors and to confirm problem situations (Mace & Lalli, 1991). Finally, prior to each functional analysis, a stimulus preference assessment was conducted based on the procedures described by Fisher, Piazza, Bowman, Hagopian, and Owens (1992). The purpose of the stimulus preference assessment was to identify potential reinforcers for relevant assessment conditions.

Assessment Procedures

Sessions lasted 10 min and were conducted one to five times per day, 3 to 5 days per week, depending on the participants' schedules. The functional analysis conditions were based on those described by Iwata et al. (1982/1994).

Positive reinforcement (attention). The participant was provided with continuous access to preferred stimuli but was ignored unless a target response occurred. Contingent on occurrences of target behavior, the experimenter made statements of concern or disapproval or physically attended to the child. The purpose of this condition was to test for a behavioral sensitivity to positive reinforcement by attention.

Positive reinforcement (tangible). The participant was provided with access to tangible stimuli just before beginning the session. When the session began, the tangible stimuli were removed from reach but were in view of the participant. Tangible stimuli were selected on the basis of reported or observed correlation with problem behavior and identification in the stimulus preference assessment. If parents and teachers did not report problems with tangible stimuli and no aberrant behavior was observed in relation to tangible items, positive reinforcement was tested only in the attention condition. Contingent on occurrences of target behavior, access to the tangible stimuli was presented for about 20 s. The purpose of this condition was to test for a behavioral sensitivity to positive reinforcement by tangible stimuli.

Negative reinforcement (escape). The participant was presented with instructions using a three-prompt sequence (verbal, touch or model, physical guidance) once every 30 s. Instructions were selected based on current education plans and reported or observed problem situations (e.g., walking, self-care, desk work). If a target behavior occurred at any point during the instructional sequence, the instruction was terminated until the next scheduled sequence. The purpose of this condition was to test for a behavioral sensitivity to escape from instructions as negative reinforcement.

No interaction/no consequence. The participant was observed in the room without access to preferred stimuli or attention. Target behaviors were not followed by any programmed consequences. The purpose of this condition was to test whether behavior occurred at higher rates in a relatively austere environment and in the absence of social contingencies.

Play. The participant was provided with continuous access to preferred stimuli, attention was available on a fixed-time (FT) 30-s schedule, and no instructional demands were presented. This condition served as a control for the aforementioned test conditions.

As discussed previously (see Figure 1), the functional analysis conditions were presented in an alternating fashion for the first two phases. During Phase 1, brief assessments (about 8 to 12 sessions) were conducted with within-session data analysis. During Phase 2, for those participants whose assessments were previously undifferentiated, overall session means were analyzed in the context of a multielement design. The 8 to 12 sessions from Phase 1 represented the first 8 to 12 sessions of the multielement analysis (thus, Phase 2 was an extension of Phase 1). During Phase 3, for those participants whose assessments continued to be undifferentiated, only no-consequence/no-interaction sessions were conducted. During Phase 4, for those participants whose behavior was extinguished during Phase 3, the experimental conditions were presented in sequential conditions characteristic of reversal designs. Thus, each phase can be viewed as an extension of the preceding phases.

RESULTS

Table 3 summarizes the results for all 20 participants. Thirty percent of the assessments were completed during Phase 1, 50% (cumulative) were completed following Phase 2, 75% (cumulative) were completed following Phase 3, and 85% (cumulative) were completed following Phase 4. Thus, the decision-making model produced differentiated outcomes for 85% of referred participants. Seven (35%) of the functional analyses identified positive reinforcement as a maintaining variable for the target behavior. Six (30%) of the functional analyses identified escape as a maintaining variable. Six (30%) of the participants showed behavior that persisted in the absence of social contingencies. Three (15%) of the functional analyses yielded inconclusive outcomes: Martin's SIB gradually decreased to zero and did not return during the assessment; Terri's SIB was only rarely observed in our assessment or in her classroom; and changes in Chester's SIB rate did not correspond to changes in our assessment conditions. The total number of behavioral functions sums to 22 rather than to 20 (the total number of

Table 3
Functional Analysis Outcomes

Name	Within session	Multielement	Extended no interaction	Reversal
CJ	Tangible			
Ron	Tangible			
Bill	Tangible			
Rick	Escape			
Sally	Tangible or escape			
Melba	No interaction			
Todd	Undifferentiated	Tangible		
Robert	Undifferentiated	Tangible		
Kevin	Undifferentiated	Escape		
Mark	Undifferentiated	Escape		
Harold	Undifferentiated	Undifferentiated	Persistence	
Barry	Undifferentiated	Undifferentiated	Persistence	
Rhonda	Undifferentiated	Undifferentiated	Persistence	
Korey	Undifferentiated	Undifferentiated	Persistence	
David	Undifferentiated	Undifferentiated	Persistence	
Ann	Undifferentiated	Undifferentiated	Extinction	Tangible or escape
Guy	Undifferentiated	Undifferentiated	Extinction	Escape
Terri	Undifferentiated	Undifferentiated	Extinction	Undifferentiated
Chester	Undifferentiated	Undifferentiated	Extinction	Undifferentiated
Martin	Undifferentiated	Undifferentiated	Extinction	Undifferentiated
Total	6/20	4/20	5/20	2/20
Cumulative	6/20	10/20	15/20	17/20
Total = 85%				

participants) because 2 participants displayed multiply controlled behavior. Specific results of each phase are summarized below.

Phase 1

Six participants showed differentiated and replicable patterns of target behavior during the brief assessment of Phase 1; 14 participants showed inconclusive patterns of target behavior during the brief assessment. Figure 2 shows representative outcomes for 2 participants with differentiated outcomes (Ron and Rick) and 2 participants with inconclusive outcomes (Robert and Kevin).

Ron's aggression occurred most frequently and consistently in the positive reinforcement (tangible) sessions, although some aggression was evident in the negative reinforcement (escape) condition. Thus, Ron's analysis shows behavioral sensitivity to tangible positive reinforcement. Rick's SIB occurred most frequently and consistently in the escape condition; in fact, only one instance of SIB occurred during other conditions.

Robert's assessment initially was relatively clear because of distinctly high levels of aggression during tangible positive reinforcement. However, his aggression decreased during the second tangible reinforcement session and was absent in the third. This failure to replicate initial effects using within-session data analysis resulted in Robert's participation in Phase 2. Kevin's Phase 1 assessment showed no differentiated patterns. It is important to note the scale differences on each figure. The scales are designed to illustrate proportional changes in behavior within subjects rather than comparisons between subjects.

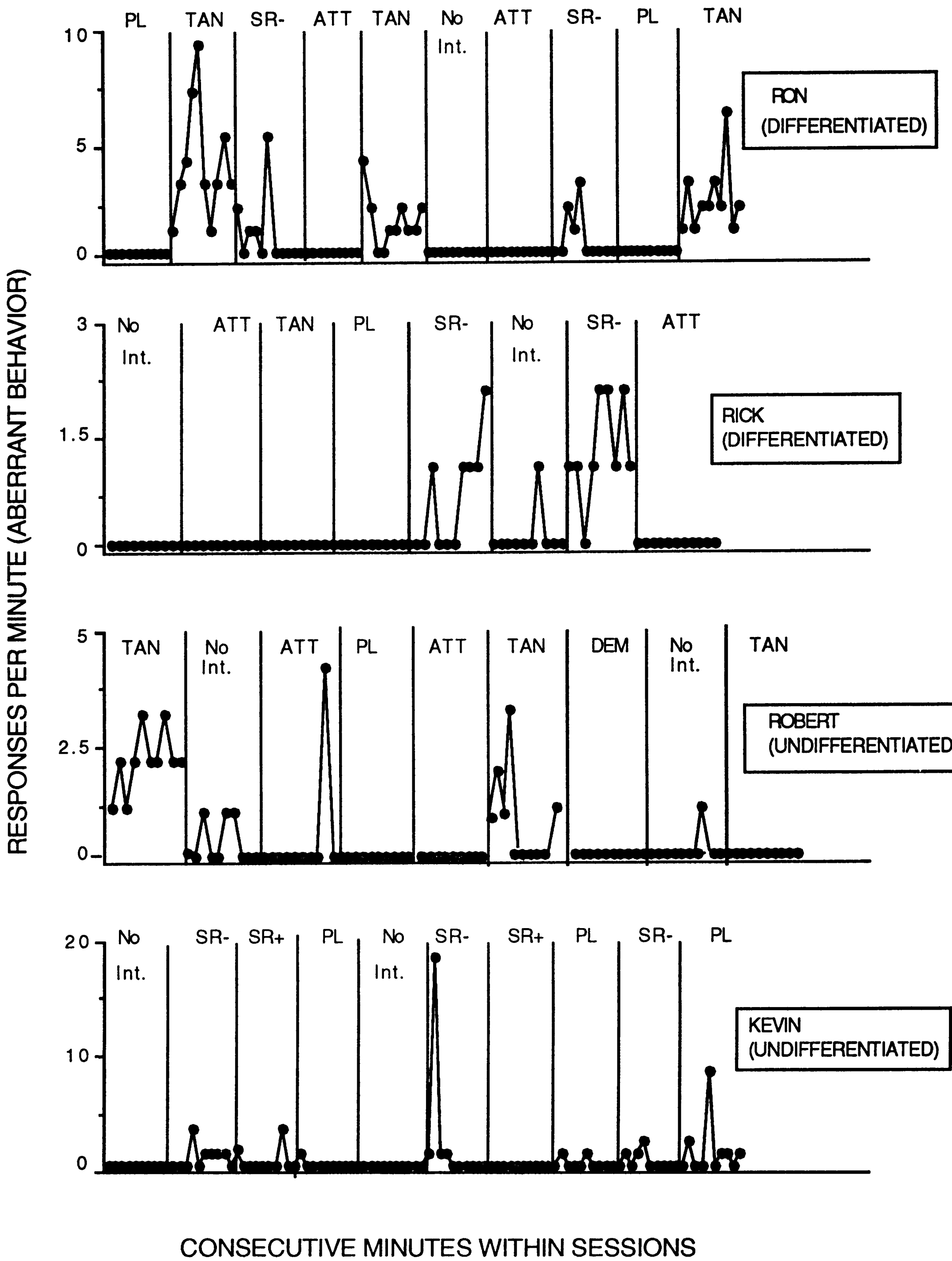

Figure 2. Phase 1. Examples of differentiated (Ron and Rick) functional analysis outcomes and inconclusive (Robert and Kevin) functional analysis outcomes using minute-by-minute response frequencies during a brief assessment.

Phase 2

Four of the remaining 14 participants showed differentiated and replicable patterns of responding during the multielement extension (Phase 2). Thus, a total of 50% of the assessments were differentiated following completion of Phase 2. Figure 3 shows the results of Robert's and Kevin's analyses, which are extensions of their brief assessment reported in Phase 1 (Figure 2). Robert's aggression during the tangible positive reinforcement condition increased again and remained higher than in the other test conditions. For Kevin, the escape condition most consistently produced high rates of SIB. Korey's assessment was undifferentiated and yielded fairly consistent levels of behavior across all test conditions.

Phase 3

Five of the remaining 10 participants displayed behavior that persisted in the absence of social consequences. Thus, a total of 75% of the assessments were completed following Phase 3. Figure 4 shows the results of Korey's no-interaction sessions as an extension of the multielement assessment. Figure 4 also shows results for 2 participants whose behavior did not persist in the absence of social contingencies (Guy and Chester). Because their target behaviors seemed to extinguish in the absence of social contingencies, they participated in Phase 4.

Phase 4

The remaining 5 individuals participated in the reversal design of Phase 4. Two of these participants showed differentiated response patterns, whereas results for the remaining 3 were inconclusive. Figure 5 shows the results of Guy's assessment. His SIB occurred at the highest rates in the escape condition. Figure 5 also shows the outcome of Chester's assessment, which was inconclusive. His SIB occurred most frequently in the positive reinforcement (attention) condition, but the decreasing trend in the first attention condition precludes definitive conclusions about the behavioral function. The other two inconclusive assessments (not depicted in the figure) resulted in sustained low rates of SIB that did not reemerge in any condition. In other words, they were inconclusive because the target behavior was rarely seen.

DISCUSSION

The results of this study replicate and extend previous findings on the functional analysis of severe behavior problems. Operant behavioral functions were identified for 17 of the 20 participants in our study. Results also suggest that decisions about assessment length can be data based. Clearly, not all assessments based on the multielement design can be completed with confidence in brief (1 to 2 hr) assessment periods; conversely, the method does not always require a large number of sessions. Several of our assessments were completed in less than 2-hr observation periods, but total observation time ranged from 80 min (for 1 participant) to over 12 hr for other participants. From a clinical perspective, if assessment periods are time limited (such as with outpatient clinic visits), functional analyses may be conducted through whichever phase is deemed feasible; with a certain proportion of clients, the time-limited assessment will be sufficient (30% in the present sample). The more sessions and phases completed, however, the more likely it is that the assessment will yield differentiated outcomes. Thus, Phase 1 could be a useful initial indication of behavioral function for some clients when more extended analyses are not possible, or when extended treatment analyses can further confirm functional relations.

The functional analyses reported in this paper illustrate the screening method we have used to identify participants for various treatment studies. For example, individuals whose behavior is differentially responsive to negative reinforcement may participate in a treatment study for escape-maintained behavior. Although treatment was not the focus of this study, it should be pointed out that target responses

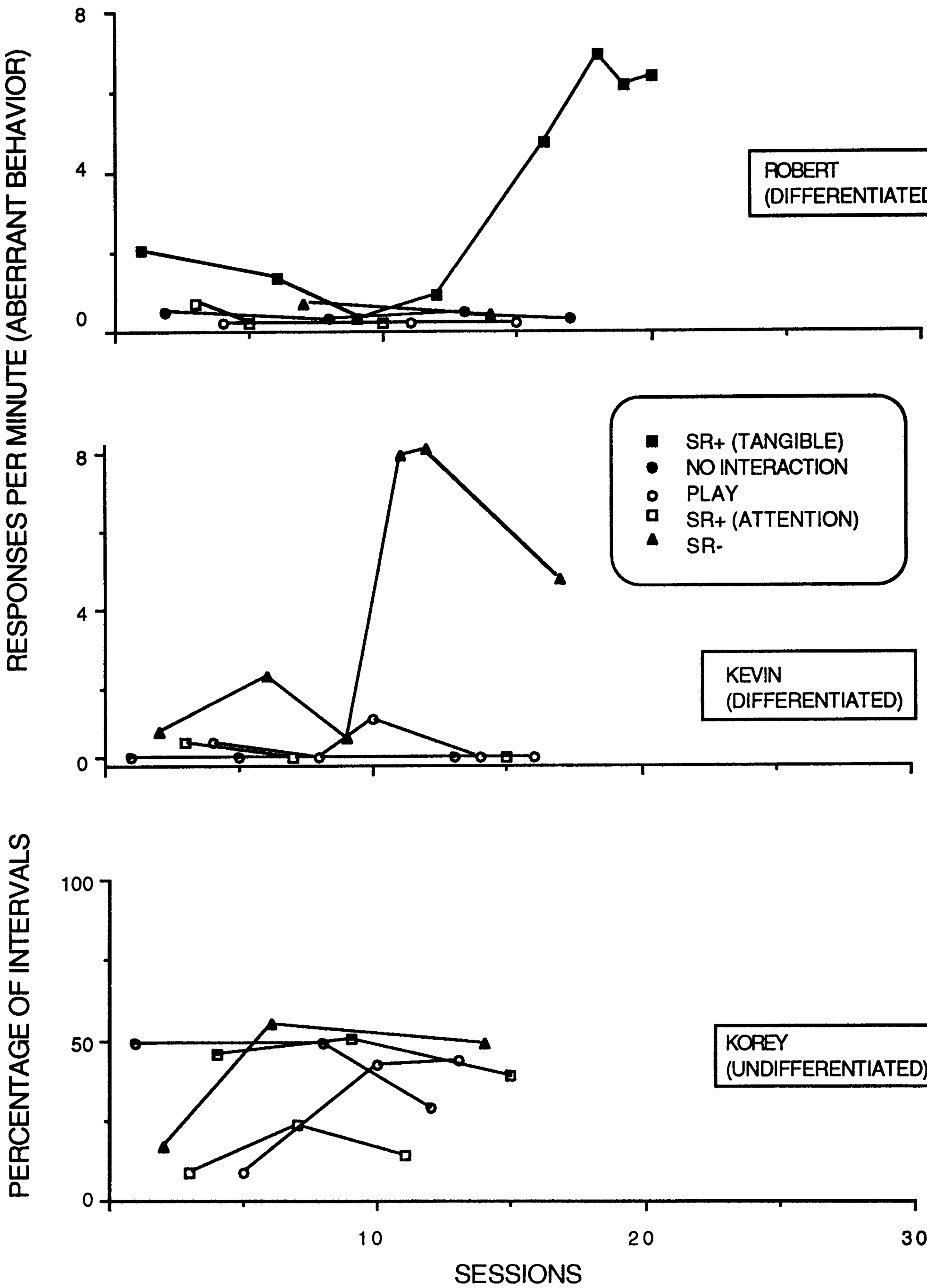

Figure 3. Phase 2. Examples of differentiated (Robert and Kevin) and inconclusive functional analysis outcomes (Korey) in the multielement analysis.

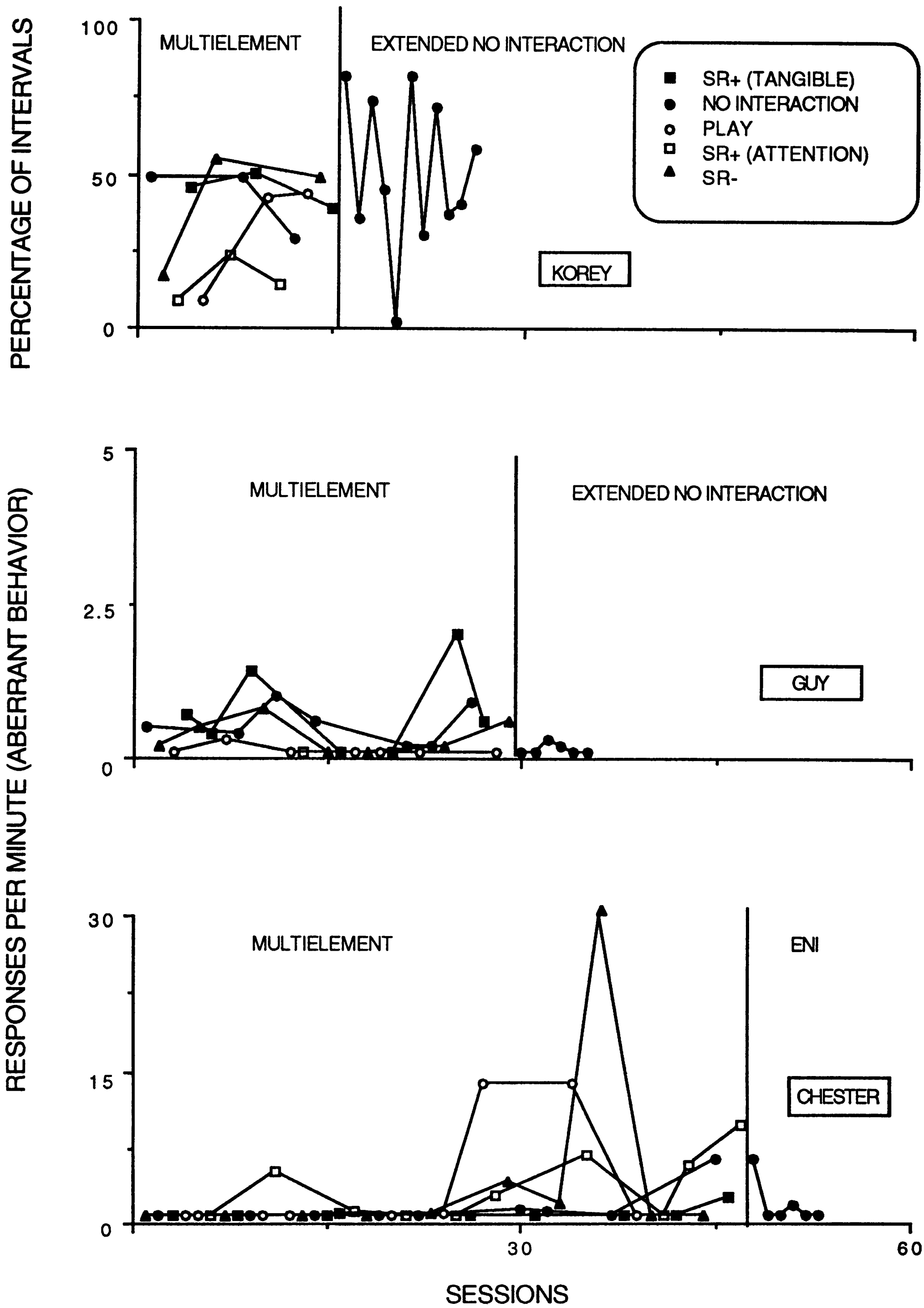

Figure 4. Phase 3. Examples of behavioral persistence during extended no-interaction observations (Korey) and extinction during extended no-interaction observations (Guy and Chester).

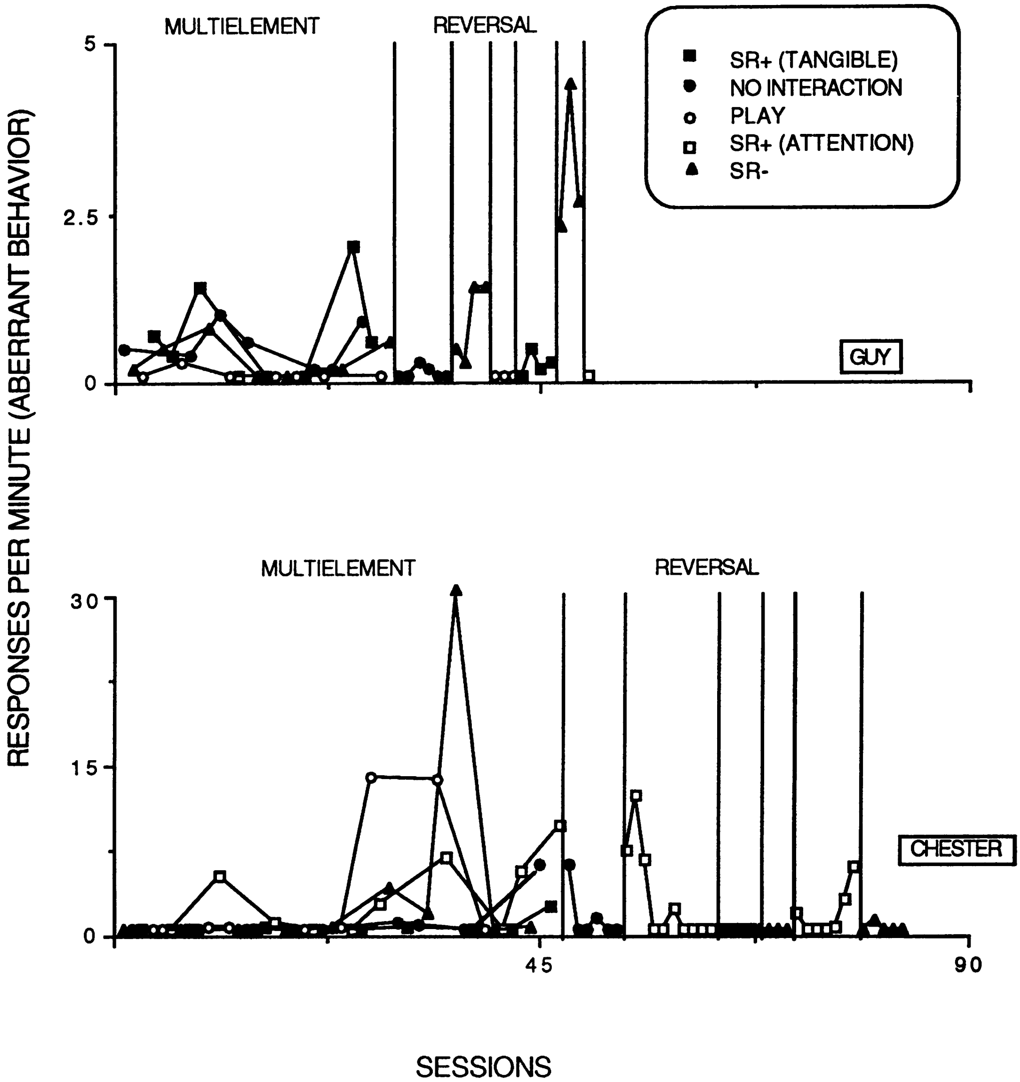

Figure 5. Phase 4. Examples of differentiated (Guy) and inconclusive (Chester) outcomes during the reversal design extension of the functional analysis.

were reduced by at least 80% for each of the 17 participants with differentiated assessment outcomes. Treatment effects are a good test of assessment validity, but treatment was not a focus of this study because positive treatment effects have been commonly reported in prior studies on functional analysis. Rather, this study can be viewed as a movement toward an empirical basis for decision making during assessment.

Given the results of previous functional analysis studies with relatively large sample sizes (e.g., Iwata, Pace, et al., 1994; Derby et al., 1992), one unexpected finding in this study was the failure to identify attention as a positive reinforcer for any of the participants. It is possible that the experimenter-provided attention functioned differently than attention provided by caregivers (i.e., parents and teachers), although this possibility needs further evaluation because the attention delivered in the Iwata et al. study also was experimenter provided. A second possibility is that the availability of preferred stimuli during the attention condition competed with attention as a source of positive reinforcement. Although the Iwata et al. (1982/1994) procedure explicitly calls for the noncontingent availability of reinforcing items during the attention condition (to control for the effects of environmental austerity), the use of a stimulus preference assessment in our study may have ensured that these items were reinforcers. Future research should evaluate competition between attention and other positive reinforcers in enriched environments. It is possible that attention would have served as a reinforcer for some participants in a relatively austere environment.

A related issue is the relatively high proportion of participants in this study whose behavior was responsive to tangible positive reinforcement. One commonly raised concern with including a tangible reinforcement condition is that the behavior may come into contact with new sources of reinforcement that were previously unrelated to the behavior. However, examination of the within-session response patterns for each participant showed that he or she immediately responded with aberrant behavior when tangible items were removed (see, e.g., Ron and Robert in Figure 1). Also, it is important to point out that almost all of the parents and teachers we interviewed prior to the study described reinforcer withdrawal as a significant problem for the participants. Finally, in no case did we use novel stimuli as tangible reinforcers in the assessment conditions. Although preferences for the items were confirmed through a formal preference assessment (Fisher et al., 1992), the items were used in the tangible condition only if parents or teachers indicated that the items (or very similar items, such as two different radios or tape players) were related to problem behavior at home or at school. Thus, given the current results, evaluations of tangible reinforcement may be underrepresented in previous research. It may be important to note that the 5 children who showed a responsiveness to tangible items were preschoolers who experienced frequent presentation and withdrawal of tangible items. Future research should examine a more formal link between reported problems related to tangible items and subsequent assessment outcomes.

The results and limitations of this study suggest numerous areas for further research. First, for those participants whose behavior persisted independent of the social environment (such as Korey), little is known about the actual mechanisms underlying the behavior. It is possible that the behavior serves to generate some specific source of reinforcement (such as endorphin production), but it is equally possible that the sources of automatically produced stimulation are highly idiosyncratic across individuals (Kennedy & Souza, 1995). Further, although an appeal to operant mechanisms is consistent with functional-analytic accounts, behavior that persists independent of the social environment may somehow be related to biological insult or exposure to toxins, among other proposed factors (Cataldo & Harris, 1982). In short, a complete analysis of nonsocially mediated aberrant behavior will probably require integrated research between biological researchers and behavior analysts.

The variables that maintained the aberrant behavior were not identified for the 3 individuals whose behavior was undifferentiated throughout each of the four phases of our assessment. It is possible that the specific types of antecedents and consequences selected for the assessments were not relevant to the actual maintaining factors in the participants' environments. These limitations suggest the need for formalized linkages between the descriptive and interview components and the analogue experimental analysis. As Carr (1994) pointed out, there could be any number of highly idiosyncratic variables that influence a given individual's behavior; it is perhaps unreasonable to expect that all behavior will respond to topographically limited stimulus sets (i.e., attention, instructional demands, etc.). Although the purpose of this study was to identify general classes of reinforcement (e.g., positive vs. negative), future research may examine more detailed methods of identifying specific functional stimuli within classes. Similarly, descriptive information could be used to identify potentially relevant reinforcement schedules, establishing operations, or antecedent events (Mace & Lalli, 1991).

A third area for future research may involve formalized decision-making rules. In this study, we used visual analysis to interpret the results of our assessments; however, such analysis is necessarily subjective. It is possible that future work could incorporate specific stability and phase-change criteria, using either relatively simple (e.g., ranges) or relatively complex (e.g., time series) statistical models.

A fourth general area of research involves the evaluation of the actual clinical utility of analogue experimental analyses in comparison to alternative assessment methods. For example, even if the analogue method is accurate for 85% of the cases and a descriptive analysis or interview is accurate for 60% of the cases, it may be efficient to begin evaluating treatment (in lieu of a functional analysis) following an initial interview. In some cases, the success or failure of a given function-based treatment could have been evaluated in a shorter time frame than an analogue assessment. However, the potential clinical utility of alternative assessments (due to brevity) does not eliminate the analytic utility of analogue assessments. That is, only one goal of applied behavior analysis is clinical outcome; another is to identify reasons why behavior occurs. The current study lends further support to the operant model of severe behavior problems, but also helps to confirm that we do not understand all of the mechanisms underlying such disorders.

REFERENCES

Carr, E. G. (1977). The motivation of self-injurious behavior: A review of some hypotheses. *Psychological Bulletin, 84,* 800–816.

Carr, E. G. (1994). Emerging themes in the functional analysis of problem behavior. *Journal of Applied Behavior Analysis, 27,* 393–399.

Carr, E. G., & Durand, M. V. (1985). Reducing behavior problems through functional communication training. *Journal of Applied Behavior Analysis, 18,* 111–126.

Cataldo, M. F., & Harris, J. (1982). The biological basis for self-injury in the mentally retarded. *Analysis and Intervention in Developmental Disabilities, 2,* 21–39.

Cooper, L. J., Wacker, D. P., Sasso, G. M., Reimers, T. M., & Donn, L. K. (1990). Using parents as therapists to evaluate behavior of their children: Application to a tertiary diagnostic clinic. *Journal of Applied Behavior Analysis, 23,* 285–296.

Day, H. M., Horner, R. H., & O'Neill, R. E. (1994). Multiple functions of problem behaviors: Assessment and intervention. *Journal of Applied Behavior Analysis, 27,* 279–289.

Derby, K. M., Wacker, D. P., Sasso, G., Steege, M., Northup, J., Cigrand, K., & Asmus, J. (1992). Brief functional assessment techniques to evaluate aberrant behavior in an outpatient clinic: A summary of 79 cases. *Journal of Applied Behavior Analysis, 25,* 713–721.

Durand, V. M., & Carr, E. G. (1992). An analysis of maintenence following functional communication training. *Journal of Applied Behavior Analysis, 25,* 777–794.

Durand, V. M., & Crimmins, D. B. (1988). Identifying variables maintaining self-injurious behavior. *Journal of Autism and Developmental Disabilities, 18,* 99–117.

Fisher, W., Piazza, C. C., Bowman, L. G., Hagopian, L. P., & Owens, J. C. (1992). A comparison of two approaches for identifying reinforcers for persons with severe and profound disabilities. *Journal of Applied Behavior Analysis, 25,* 491–498.

Higgins Hains, A., & Baer, D. M. (1989). Interaction effects in multielement designs: Inevitable, desirable, and ignorable. *Journal of Applied Behavior Analysis, 22,* 57–69.

Horner, R. D. (1980). The effects of an environmental "enrichment" program on the behavior of institutionalized profoundly retarded children. *Journal of Applied Behavior Analysis, 13,* 473–491.

Iwata, B. A., Dorsey, M. F., Slifer, K. J., Bauman, K. E., & Richman, G. S. (1994). Toward a functional analysis of self-injury. *Journal of Applied Behavior Analysis, 27,* 197–209. (Reprinted from *Analysis and Intervention in Developmental Disabilities, 2,* 3–20, 1982)

Iwata, B. A., Duncan, B. A., Zarcone, J. R., Lerman, D. C., & Shore, B. A. (1994). A sequential, test-control methodology for conducting functional analyses of self-injurious behavior. *Behavior Modification, 18,* 289–306.

Iwata, B. A., Pace, G. M., Dorsey, M. F., Zarcone, J. R., Vollmer, T. R., Smith, R. G., Rodgers, T. A., Lerman, D. C., Shore, B. A., Mazaleski, J. L., Goh, H., Cowdery, G. E., Kalsher, M. J., McCosh, K. C., & Willis, K. D. (1994). The functions of self-injurious behavior: An experimental-epidemiological analysis. *Journal of Applied Behavior Analysis, 27,* 215–240.

Kennedy, C. H., & Souza, G. (1995). Functional analysis and treatment of eye poking. *Journal of Applied Behavior Analysis, 28,* 27–37.

Mace, F. C. (1994). The significance and future of functional analysis methodologies. *Journal of Applied Behavior Analysis, 27,* 385–392.

Mace, F. C., & Lalli, J. S. (1991). Linking descriptive and experimental analysis in the treatment of bizarre speech. *Journal of Applied Behavior Analysis, 24,* 553–562.

Northup, J., Wacker, D., Sasso, G., Steege, M., Cigrand, K., Cook, J., & DeRaad, A. (1991). A brief functional analysis of aggressive and alternative behavior in an outclinic setting. *Journal of Applied Behavior Analysis, 24,* 509–522.

O'Neill, R. E., Horner, R. H., Albin, R. W., Storey, K., & Sprague, J. (1990). *Functional analysis of problem behavior: A practical assessment guide.* Pacific Grove, CA: Brooks/Cole.

Repp, A. C., & Karsh, K. G. (1994). Hypothesis-based intervention for tantrum behaviors of persons with developmental disabilities in school settings. *Journal of Applied Behavior Analysis, 27,* 21–31.

Rincover, A. (1978). Sensory extinction: A procedure for eliminating self-stimulatory behavior in developmentally disabled children. *Journal of Abnormal Child Psychology, 6,* 299–310.

Smith, R. G., Iwata, B. A., Vollmer, T. R., & Zarcone, J. R. (1993). Experimental analysis and treatment of multiply controlled self-injury. *Journal of Applied Behavior Analysis, 26,* 183–196.

Vollmer, T. R., Iwata, B. A., Duncan, B. A., & Lerman, D. C. (1993). Extensions of multielement functional analyses using reversal-type designs. *Journal of Developmental and Physical Disabilities, 5,* 311–325.

Vollmer, T. R., Iwata, B. A., Zarcone, J. R., Smith, R. G., & Mazaleski, J. L. (1993). Within-session patterns of self-injury as indicators of behavioral function. *Research in Developmental Disabilities, 14,* 479–492.

Vollmer, T. R., Marcus, B. A., & LeBlanc, L. (1994). Treatment of self-injury and hand mouthing following inconclusive functional analyses. *Journal of Applied Behavior Analysis, 27,* 331–344.

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